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the best medium through which to gain a knowledge of general chemistry either of the metals or the non-metals; indeed it is probable that the importance of qualitative analysis has been much over-estimated. It is of course necessary for those who intend to make a thorough study of the science, but the majority of college students do not pursue chemistry more than a single year, and it should not be difficult to devise a year's course in chemistry in which the student would gain far more knowledge of chemistry and more intellectual development than in the ordinary course, where such a large portion of the time is spent on qualitative analysis. There are dozens of laboratory manuals before us, in many, not to say most, of which the author's effort has apparently been to boil the matter down to the least possible space; the result has been the production of a series of more or less extended tables which the student follows blindly in searching for the contents of his unknown solutions, knowing nothing of the reasons for any step and gaining no knowledge of chemistry. Indeed, one may become a good analyst and know little of chemistry.

There are however teachers who use qualitative analysis as merely a medium of instruction in chemistry; who subordinate the acquisition of analytical skill to the acquisition of a knowledge of general chemistry and chemical theory. Such an one is the author of this book, and the present edition of his manual is the fruit of over three decades of laboratory teaching. The result is not a manual for self-instruction, but rather a guide to be used under the immediate supervision and instruction of a competent teacher.

The first half of the book is devoted to the reactions of the more common bases and acids, the students working with known solutions of a single salt and writing out each reaction on the blank pages with which this part of the book is interleaved. In this manner the student becomes familiar with these reactions, which represent all the ordinary ones used in qualitative and quantitative analysis. As he progresses in this work he is supposed to be furnished with solutions of unknown single salts for determination. This part is also intended to be supplemented by a course of lectures on

the metals and their compounds. The second part of the book is devoted to the systematic examination of solids. The method used here is that which was first introduced by the author and is now with greater or lesser modifications generally in use. It is safe to say, however, that little improvement has been made upon the original.

This is followed by qualitative separations. Here, while alternate methods are now and then given, the methods are generally confined to that one in each case which has proved itself best in the author's experience. There is a decided advantage in thus limiting the possible modes of procedure, as freedom of choice is confusing to the novice. Indispensable as Fresenius is to the advanced student, it is almost useless to the inexperienced.

A supplement gives fully the reactions of nearly all the rare elements, while a chapter in the appendix on the preparation of reagents will be useful to teachers. The earlier editions of the book have proved its success in the hands of no inconsiderable number of teachers beside the author, and this revised edition, which is a very considerable improvement on those which have preceded it, will be found even more valuable. If chemistry is to continue to be taught as largely through qualitative analysis as it has been in the past, this manual may safely be recommended as the best of its class. It is the writer's hope, however, that the day is not far distant when the improvement will be not along the old lines, but in the methods of chemical teaching themselves. The general style and make-up of the the book is good, but it is unfortunately marred by poor proof-reading.

JAS. LEWIS HOWE.

WASHINGTON AND LEE UNIVERSITY,

LEXINGTON, VA., October 19, 1895.

La sensibilité de l'œil aux couleurs spectrales.
M. H. PARINAUD. *Revue Scientifique*, Sér. 4, T. 4, 134—141. August 3, 1895.

In the *Revue Scientifique* for June 8, Parinaud described an interesting series of experiments on the relative sensibility of the adapted and unadapted eye to spectral colors.* In the issue of the same journal for August 3 he gives his

*See review in SCIENCE, II., 418, Sept. 27, 1895.

physiological deductions. The experiments brought out three important facts, namely, (1) adaptation (20-30 minutes stay in darkness) affects the sensibility for colors unequally. Beginning at zero for the red, the improvement increases as the wave-length shortens till for the violet it is very considerable; (2) adaptation does not make the colors seem more intense as colors, but only more luminous, as if white light had been added; and this may reach such a pitch with very faint lights that the colors are wholly lost in the white light; (3) the sensibility of the *fovea* is unaffected by adaptation.

On these facts Parinaud bases a theory of the rods and cones and the visual purple. In the *fovea* there are cones only, and, as everywhere, they are without purple. Adaptation appears to be an affair of the rods and the purple; it takes place where they are found, and fails where they are absent. Since the luminosity alone is affected, it is natural to regard them as an end-organ for luminosity only, leaving the cones to mediate color. The matter is not so simple, however, as a mere separation of the organs, for the cones must also mediate white, and, indeed, in Parinaud's opinion, could do nothing more than that without the coöperation of the cerebral centers. Hemeralopia (night-blindness), which appears to be due to a deficiency in the purple, confirms this theory of its function, as also does the good development of the rods and purple in the eyes of nocturnal animals. The purple is able to increase the effect of faint lights because of a fluorescent or phosphorescent property. Parinaud's arguments for such a property make a very plausible case. If he is correct the purple becomes an agent for the actual production of light on faint luminous stimulation instead of an agent for increasing the irritability of the visual apparatus. The paper concludes with a fairly full account of the work of other observers in related lines.* The contribution is important in bringing together a number of more or less disregarded facts and showing their very great physiological significance.

E. C. SANFORD.

*The reviewer hastens to withdraw his criticism of the first part of M. Parinaud's paper for deficiency in this respect.

Geology of the Green Mountains in Massachusetts.

By RAPHAEL PUMPELLY, J. E. WOLFF and T. NELSON DALE. Monograph XXIII of the United States Geological Survey. 1894. 4°. Pp. xiv, 206. Plates 23. Price \$1.30.

The monograph before us is the most detailed and valuable contribution yet made to the solution of the much debated 'Taconic question,' than which none other has achieved greater prominence or excited more bitter feeling in the last fifty years of American geology.

Since the discovery of actual fossils in the metamorphosed strata of Vermont by the Rev. Augustus Wing, the labors of many have indicated the true relations that are now demonstrated, yet nevertheless the difficulties of the problem were so great, and the tendency to generalize without detailed field work had been so marked, that Mr. Pumpelly and his co-laborers decided to throw aside all previous conclusions and by detailed and patient observation, based upon topographic maps in a crucial area, to trace out step by step the relations of these much disturbed and metamorphosed sediments. Accordingly the northwest corner of Massachusetts was selected and study was focused especially upon Hoosac Mountain on the east, Greylock Mountain on the west and the valley between. Hoosac Mountain, well known for the famous tunnel that penetrates it, is an anticlinorium with a core of granitic pre-Cambrian gneiss (the Stamford gneiss), on which rests, with conformable lamination, another variable white gneiss that is at times a recognizable conglomerated and even a quartzite (the Vermont formation). Above the last and still conformable is a great thickness of albite schist (the Hoosac schist), which is itself succeeded on the east by the Rowe schist. The Vermont formation is Cambrian; the Hoosac schist is Cambrian below, Silurian above. The Rowe schist is Silurian and of minor importance in the problem. On the west side of Hoosac Mountain the Hoosac schist fails and the Vermont formation runs under the Cambro-Silurian Stockbridge limestone that has been degraded to form the valley. It should be remarked that all the strata of Hoosac Mountain proper, except the Stamford gneiss, are metamorphosed *clastics*.

Greylock Mountain, with its spurs, is a